1. (original) A method for preparing a cycloolefin polymer containing polar functional groups, comprising:

preparing a catalyst mixture including

i) a precatalyst represented by Chemical Formula 1, containing a Group 10 transition metal having a ligand containing oxygen ions bonded to the metal;

ii) a first cocatalyst which is an organic compound containing a Group 15 element; and

iii) a second cocatalyst which is capable of providing an anion and weakly coordinating to the metal of the precatalyst; and

subjecting a monomer solution comprising a norbornene-based compound containing a polar functional group to an addition polymerization reaction in the presence of an organic solvent and the catalyst mixture, at a temperature of 80-200 ℃, the total amount of the organic solvent being 50-800 % by weight based on the total weight of the monomer contained in the monomer solution, and the product yield of the polymer being 50% by weight or more based on the total weight of the monomer.

Chemical Formula 1

$[-O-(A)-O-]_nM(R^1)_{2n}$

wherein

M is a Group 10 transition metal;

n is 1 or 2;

A represents a linear or branched C_{1-20} alkyl, aryl, aralkyl, alkenyl group or a linear or branched C_{1-20} alkyl, aryl, aralkyl or alkenyl group containing a hetero atom including Si, Ge, S, O, or N;

R^1 is hydrogen; a linear or branched C_{1-20} alkyl, alkenyl or vinyl group; a C_{3-12} cycloalkyl group unsubstituted or substituted with a hydrocarbon; a C_{6-40} aryl group unsubstituted or substituted with a hydrocarbon; a C_{6-40} aryl group containing at least one hetero atom; a C_{7-15} aralkyl group unsubstituted or substituted with a hydrocarbon; or a C_{3-20} alkynyl group.

2. (original) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 1, wherein the organic compound of the first cocatalyst has an unshared electron pair and serves as an electron donor and is represented by Chemical Formula 2:

Chemical Formula 2

$$D\text{-}(R^2)_{3-c}[X(R^2)_d]_c$$

wherein

D is a Group 15 element,

c is an integer of 0 to 3,

X is an oxygen, sulfur, nitrogen or silicon,

d is 1 when X is an oxygen or sulfur, 2 when X is a nitrogen atom, or 3 when X is a silicon,

R^2 is hydrogen; a linear or branched C_{1-20} alkyl, alkoxy, allyl, alkenyl or vinyl group; a C_{3-12} cycloalkyl group unsubstituted or substituted with a hydrocarbon; a C_{6-40} aryl group unsubstituted or substituted with a hydrocarbon; a C_{7-15} aralkyl group unsubstituted or substituted with a hydrocarbon; a C_{3-20} alkynyl group; a tri(linear or

branched C_{1-10} alkyl) silyl or tri(linear or branched C_{1-10} alkoxy) silyl group; a tri(C_{3-12} cycloalkyl unsubstituted or substituted with a hydrocarbon) silyl group; a tri(C_{6-40} aryl unsubstituted or substituted with a hydrocarbon) silyl group; a tri(C_{6-40} aryloxy unsubstituted or substituted with a hydrocarbon) silyl group; a tri(linear or branched C_{1-10} alkyl) siloxy group; a tri(C_{3-12} cycloalkyl unsubstituted or substituted with a hydrocarbon) siloxy group; or tri(C_{6-40} aryl unsubstituted or substituted with a hydrocarbon) siloxy group, in which all these substituents may be substituted with a linear or branched haloalkyl group or a halogen.

Chemical Formula 3

$(R^3)_2D\text{-}(R^4)\text{-}D(R^3)_2$

wherein

D is a Group 15 element,

R^3 is as defined in R^2 of Chemical Formula 3;

R^4 is a linear or branched C_{1-5} alkyl, alkenyl or vinyl group; a C_{3-12} cycloalkyl group unsubstituted or substituted with a hydrocarbon; a C_{6-20} aryl group unsubstituted or substituted with a hydrocarbon; or a C_{7-15} aralkyl group unsubstituted or substituted with a hydrocarbon.

3. (original) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 1, wherein the second cocatalyst is a salt represented by Chemical Formula 4:

Chemical Formula 4

$[Cation]_a[Anion]_b$

wherein

Cation is selected from the group consisting of proton; cations of Group 1 and 2 metals; and organic groups containing these cations, to which unshared electron pairs of the organic compound of the first catalyst may be bonded;

Anion is an anion capable of weakly coordinating to the metal M of the precatalyst, and is selected from the group consisting of borate, aluminate, $[SbF_6]$, $[PF_6]$, $[AsF_6]$, perfluoroacetate ($[CF_3CO_2]$), perfluoropropionate ($[C_2F_5CO_2]$), perfluorobutyrate ($[CF_3CF_2CF_2CO_2]$), perchlorate ($[ClO_4]$), p-toluenesulfonate ($[p\text{-}CH_3C_6H_4SO_3]$), $[SO_3CF_3]$, boratabenzene, and carborane unsubstituted or substituted with a halogen atom; and

a and b are the number of the cations and anions, respectively, and determined to allow the cation and anion to be electrically neutralized and balance the charges.

4. (original) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 3, wherein the organic group containing the cation of Chemical Formula 4 is selected from the group consisting of ammoniums $[NH(R^5)_3]^+$, $[NH_2(R^5)_2]^+$, $[NH_3(R^5)_1]^+$, and $[N(R^5)_4]^+$; phosphoniums $[PH(R^5)_3]^+$, $[PH_2(R^5)_2]^+$, $[PH_3(R^5)_1]^+$, and $[P(R^5)_4]^+$; carboniums $[C(R^5)_3]^+$; $[H(OEt_2)_2]^+$; $[Ag]^+$; and $[Cp_2Fe]^+$, in

which R^5 is a linear or branched C_{1-20} alkyl group; an alkyl or silylalkyl group substituted with a halogen; a C_{3-12} cycloalkyl group unsubstituted or substituted with a hydrocarbon; a cycloalkyl or silyl cycloalkyl group substituted with a halogen; a C_{6-40} aryl group unsubstituted or substituted with a hydrocarbon; an aryl or silyl aryl group substituted with a halogen; a C_{7-15} aralkyl group unsubstituted or substituted with a hydrocarbon; or an aralkyl or silyl aralkyl group substituted with a halogen.

5. (original) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 3, wherein the borate or aluminate of Chemical Formula 4 is an anion represented by Chemical Formula 4a or 4b:

Chemical Formula 4a

$[M'(R^6)_4]$

Chemical Formula 4b

$[M'(OR^6)_4]$

wherein

M' is a boron or aluminum;

R^6 is a halogen; a linear or branched C_{1-20} alkyl or alkenyl group unsubstituted or substituted with a halogen atom; a C_{3-12} cycloalkyl group unsubstituted or substituted with a halogen; a C_{6-40} aryl group which unsubstituted or substituted with a hydrocarbon; a C_{6-40} aryl group substituted with a linear or branched C_{3-20} trialkylsiloxy group or a linear or branched C_{18-48} triarylsiloxy group; or a C_{7-15} aralkyl group

unsubstituted or substituted with a halogen.

6. (original) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 1, wherein the organic solvent is selected from the group consisting of dichloromethane, dichloroethane, toluene, chlorobenzene and mixtures thereof.

7. (original) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 1, wherein the total amount of the organic solvent is 50-400 % by weight based on the total weight of the monomer contained in the monomer solution.

8. (original) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 1, wherein the total amount of the organic solvent is 50-200 % by weight based on the total weight of the monomer contained in the monomer solution.

9. (original) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 1, wherein the polymerization reaction is performed at a temperature of 80-170°C.

10. (original) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 1, wherein the polymerization reaction is performed at a temperature of 80-150°C.

11. (original) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 1, wherein the catalyst mixture includes a metal catalyst complex containing a cation complex made of the precatalyst and the first cocatalyst and an anion complex made of the second cocatalyst.

12. (original) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 1, wherein the catalyst mixture comprises, based on 1 mole of the precatalyst containing Group 10 transition metal, 1-3 moles of the first cocatalyst containing the organic compound containing the Group 15 element; and 1-2 moles of the second cocatalyst which is capable of providing an anion and weakly coordinating to the metal of the precatalyst.

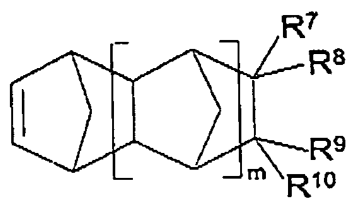
13. (original) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 1, wherein the molar ratio of the catalyst mixture based on the Group 10 transition metal compound to the monomer contained in the monomer solution is in the range of 1:2,500 - 1:100,000.

14. (original) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 1, wherein the polar functional group of the norborene-based compound includes an ester group and an acetyl group.

15. (original) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 1, wherein the norbornene-based compound

containing a polar functional group is represented by the following Chemical Formula 5:

Chemical Formula 5



wherein

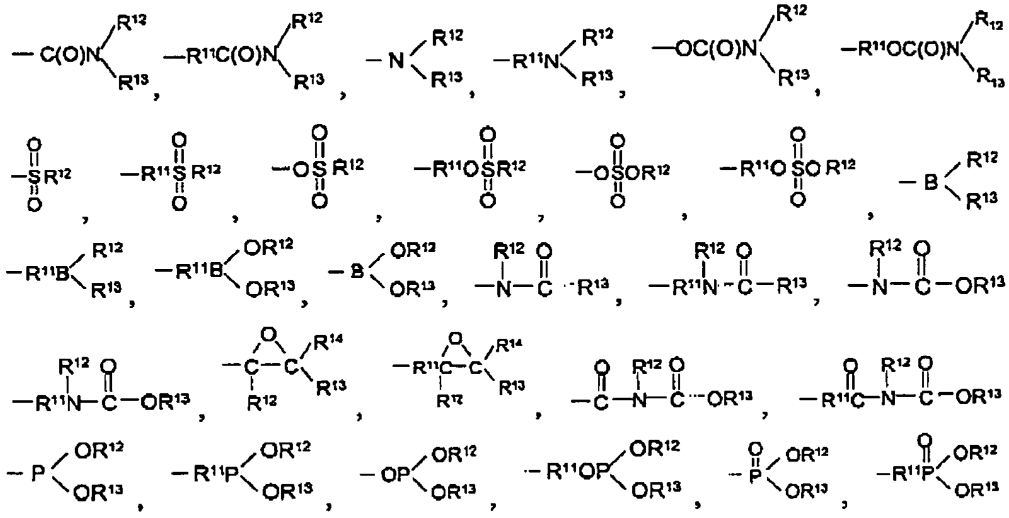
m is an integer of 0 to 4,

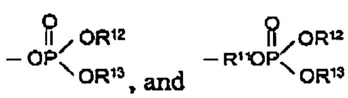
at least one of R^7, R^8, R^9 and R^{10} is a polar functional group, the others are non-polar functional group, and R^7, R^8, R^9 and R^{10} can be bonded together to form a saturated or unsaturated C_{1-20} cyclic group or C_{6-24} aromatic ring;

the non-polar functional group includes hydrogen; halogen; a linear or branched C_{1-20} alkyl group; , a linear or branched C_{1-20} haloalkyl group; a linear or branched C_{1-20} alkenyl group; a linear or branched C_{1-20} hoalalkenyl group; a linear or branched C_{3-20} alkynyl group; a linear or branched C_{3-20} haloalkynyl; a C_{3-12} cycloalkyl group unsubstituted or substituted with alkyl, alkenyl, alkynyl, halogen, haloalkyl, haloalkenyl, or haloalkynyl; a C_{6-40} aryl group unsubstituted or substituted with alkyl, alkenyl, alkynyl, halogen, haloalkyl, haloalkenyl, or haloalkynyl; and a C_{7-15} aralkyl group unsubstituted or substituted with alkyl, alkenyl, alkynyl, halogen, haloalkyl, haloalkenyl, or haloalkynyl;

the polar functional group is a non-hydrocarbonaceous polar group containing at least one of O, N, P, S, Si and B, and is selected from the group consisting of: OR^{12}, $OC(O)OR^{12}$, $R^{11}OC(O)OR^{12}$, $C(O)R^{12}$, $R^{11}C(O)R^{12}$, $OC(O)R^{12}$, $R^{11}OC(O)R^{12}$,

$(R^{11}O)pOR^{12}$, $(OR^{11})pOR^{12}$, $C(O)OC(O)R^{12}$, $R^{11}C(O)OC(O)R^{12}$, SR^{12}, $R^{11}SR^{12}$, SSR^{12}, $R^{11}SSR^{12}$, $S(=O)R^{12}$, $R^{11}S(=O)R^{12}$, $R^{11}C(=S)R^{12}$, $R^{11}C(=S)SR^{12}$, $R^{11}SO3R^{12}$, $SO3R^{12}$, $R^{11}N=C=S$, NCO, $R^{11}NCO$, CN, $R^{11}CN$, $NNC(=S)R^{12}$, $R^{11}NNC(=S)R^{12}$, NO2, $R^{11}NO2$,





,in which R^{11} is a linear or branched C_{1-20} alkyl group; , a linear or branched C_{1-20} haloalkyl group; a linear or branched C_{1-20} alkenyl group; a linear or branched C_{1-20} hoalalkenyl group; a linear or branched C_{3-20} alkynyl group; a linear or branched C_{3-20} haloalkynyl; a C_{3-12} cycloalkyl group unsubstituted or substituted with alkyl, alkenyl, alkynyl, halogen, haloalkyl, haloalkenyl, or haloalkynyl; a C_{6-40} aryl group unsubstituted or substituted with alkyl, alkenyl, alkynyl, halogen, haloalkyl, haloalkenyl, or haloalkynyl; and a C_{7-15} aralkyl group unsubstituted or substituted with alkyl, alkenyl, alkynyl, halogen, haloalkyl, haloalkenyl, or haloalkynyl;

R^{12}, R^{13}, and R^{14} are each independently hydrogen; a halogen; a linear or branched C_{1-20} alkyl group; a linear or branched C_{1-20} haloalkyl group; a linear or branched C_{1-20} alkenyl group; a linear or branched C_{1-20} hoalalkenyl group; a linear or

branched C_{3-20} alkynyl group; a linear or branched C_{3-20} haloalkynyl; a C_{3-12} cycloalkyl group unsubstituted or substituted with alkyl, alkenyl, alkynyl, halogen, haloalkyl, haloalkenyl, or haloalkynyl; a C_{6-40} aryl group unsubstituted or substituted with alkyl, alkenyl, alkynyl, halogen, haloalkyl, haloalkenyl, or haloalkynyl; a C_{7-15} aralkyl group unsubstituted or substituted with alkyl, alkenyl, alkynyl, halogen, haloalkyl, haloalkenyl, or haloalkynyl; or alkoxy, haloalkoxy, carbonyloxy, halocarbonyloxy; and p is an integer of 1 to 10.

16. (original) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 1, wherein the monomer solution further comprises a cycloolefin compound containing no polar functional group.

17. (original) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 16, wherein the molar ratio of the cycloolefin compound containing no polar functional group is 30 % by mole based on the total monomers contained in the monomer solution.

18. (original) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 1, wherein the cycloolefin polymer containing polar functional groups includes a homopolymer of a cycloolefin monomer containing a polar functional group, a copolymer of cycloolefin monomers containing different polar functional groups, and a copolymer of cycloolefin momomers containing a polar functional group and cycloolefin monomers containing no polar functional group.

19. (original) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 1, wherein a molecular weight (Mw) of the cycloolefin polymer containing polar functional groups is in the range of 100,000-1,000,000.

20. (original) An optical anisotropic film comprising a cycloolefin polymer containing polar functional groups which is prepared by a method as claimed in claim 1 and has a molecular weight of 100,000 or more.

21. (original) The optical anisotropic film according to claim 20, wherein the optical anisotropic film has 70 to 1000 nm of a retardation value (Rth), as defined by the following equation 1:

(Equation 1)

$R_{th} = \Delta(n_y - n_z) \times d$

wherein, n_y is a refractive index in a fast axis direction in a plane, measured at a wavelength of 550 nm;

n_z is a refractive index in a thickness direction, measured at a wavelength of 550nm; and

d is the film thickness.

22. (original) The optical anisotropic film according to claim 20, the refractive index of the optical anisotropic film satisfies the following equation 3:

(Equation 3)

$nx \cong ny > nz$

wherein, nx is a refractive index in a slow axis direction in a plane, ny is a refractive index in a fast axis direction in the plane, and nz is a refractive index in a thickness direction.

23. (original) The optical anisotropic film according to claim 22, wherein the optical anisotropic film is used as a negative C-plate type optical compensation film for Liquid Crystal Displays.

24. (original) A display device comprising an optical anisotropic film as claimed in claim 20.

25. (New) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 1, wherein i) the precatalyst is selected from the group consisting of an Pd(acetyl acetonate)$_2$, Pd(acetate)$_2$, (acetate)Pd(acetyl acetonate), (allyl)Pd(acetyl acetonate), and (allyl)Pd(acetate).

26. (New) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 1, wherein ii) the first cocatalyst is tricyclohexylphosphine.

27. (New) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 1, wherein iii) the second cocatalyst is dimethyl aniliniumtetrakis(pentafluorophenyl)borate.

28. (New) The method for preparing a cycloolefin polymer containing polar functional groups according to claim 1, wherein the norbornene-based compound contains a polar functional group selected from the group consisting of 5- norbornene-2-carboxylic acid methyl ester, 5- norbornene-2-carboxylic acid butyl ester, 5-norbornene-2-allylacetate, 5- norbornene-2-acetate.